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(54) **ARMING APPARATUS**

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**F42C 14/06** (2006.01)

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CPC ..... **B64D 1/04** (2013.01); **F42C 15/40** (2013.01); **F42C 14/06** (2013.01); **F42C 15/20** (2013.01)

(58) **Field of Classification Search**

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F42C 15/20; B64D 1/04; B64D 1/06

See application file for complete search history.

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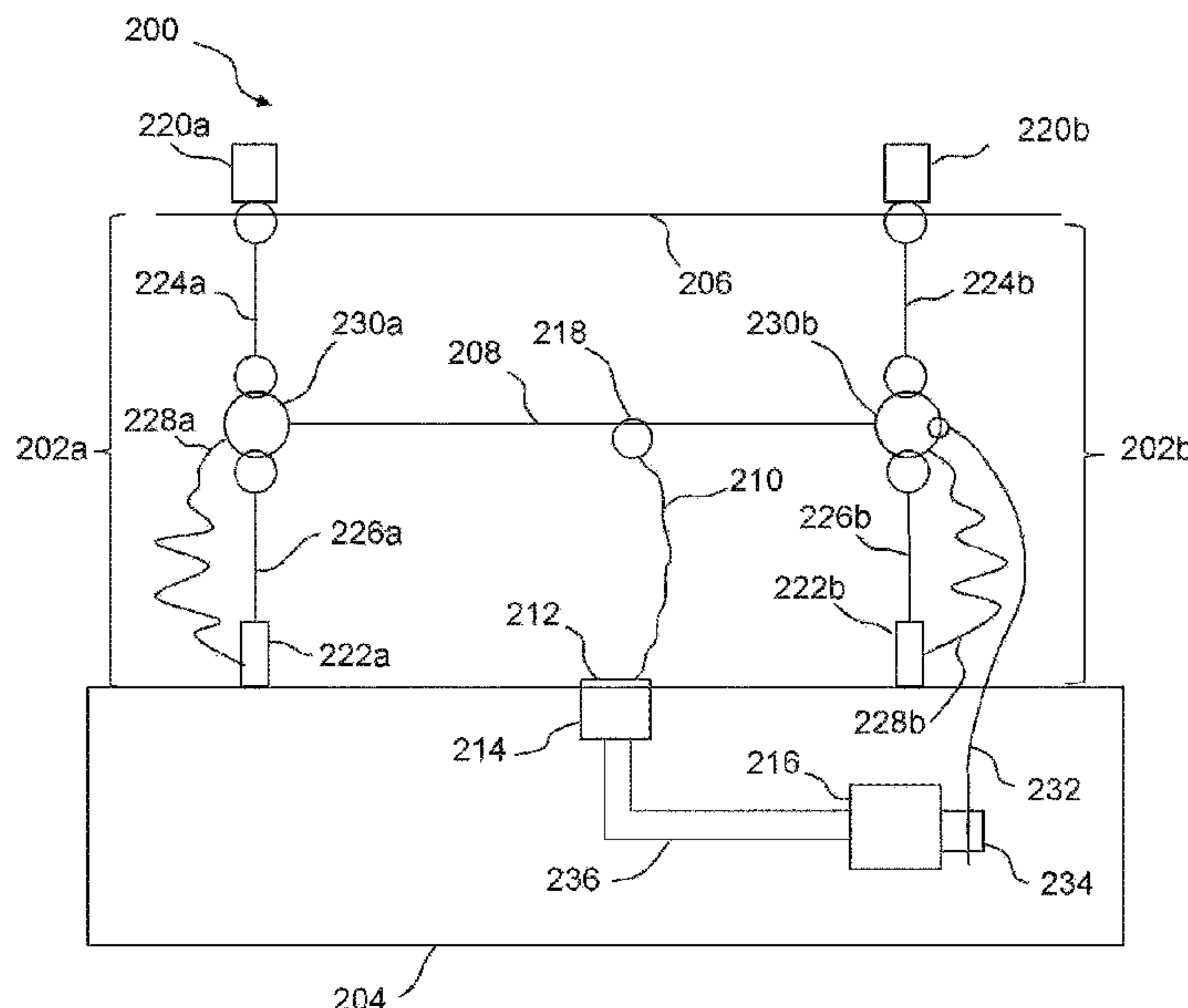
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(57) **ABSTRACT**

There is provided an arming apparatus for a store, the apparatus comprising: a first attachment system and a second attachment system; a linking connector coupled with the first attachment system and the second attachment system; and an arming connector coupled with the linking connector and a first fuze input of the store; wherein each of the first attachment system and the second attachment system comprises: an arming unit; a first frangible connector coupled with the arming unit and the linking connector; and a second frangible connector coupled with the linking connector and the store.

**15 Claims, 14 Drawing Sheets**



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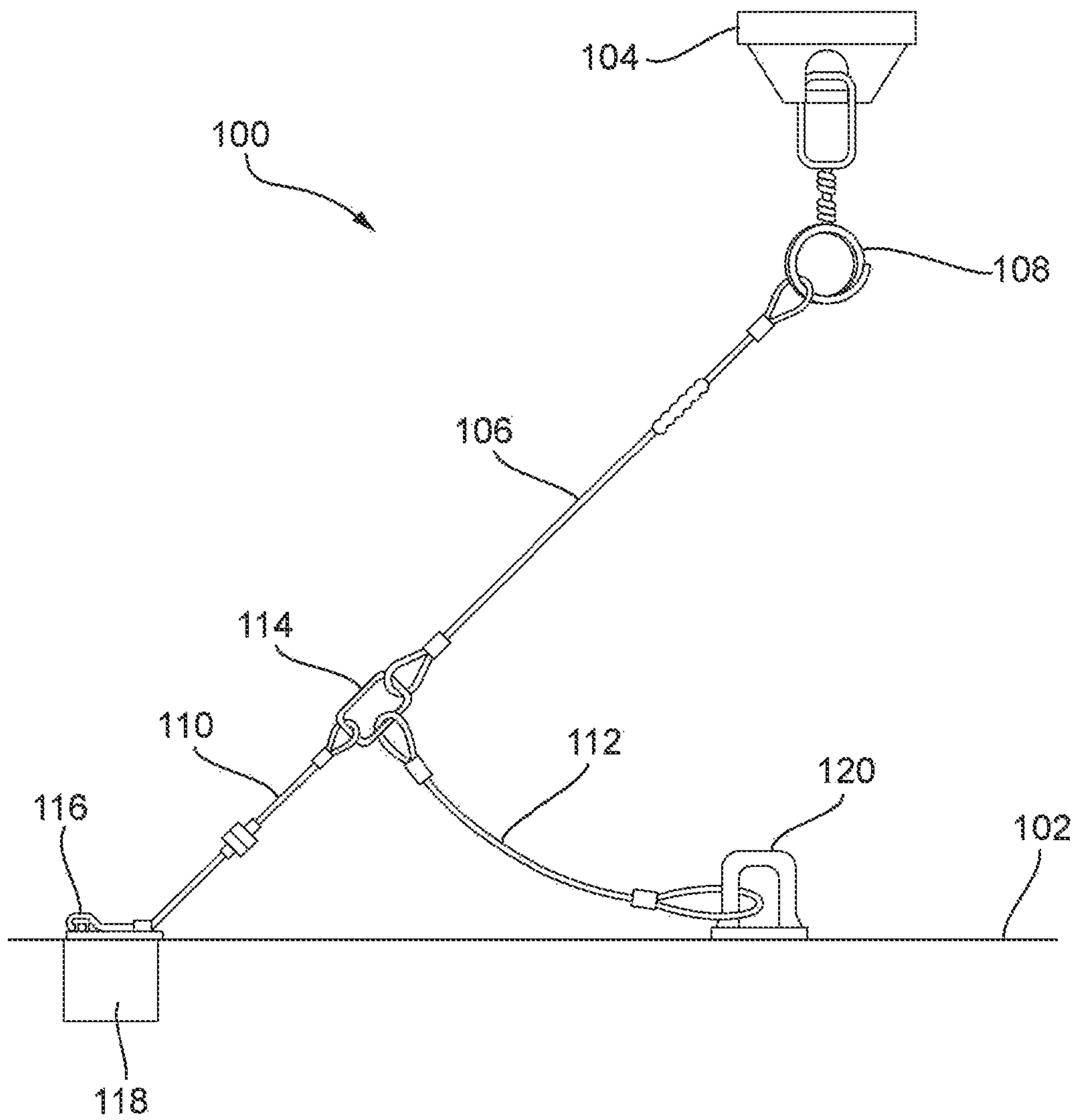
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Fig. 1

Prior Art



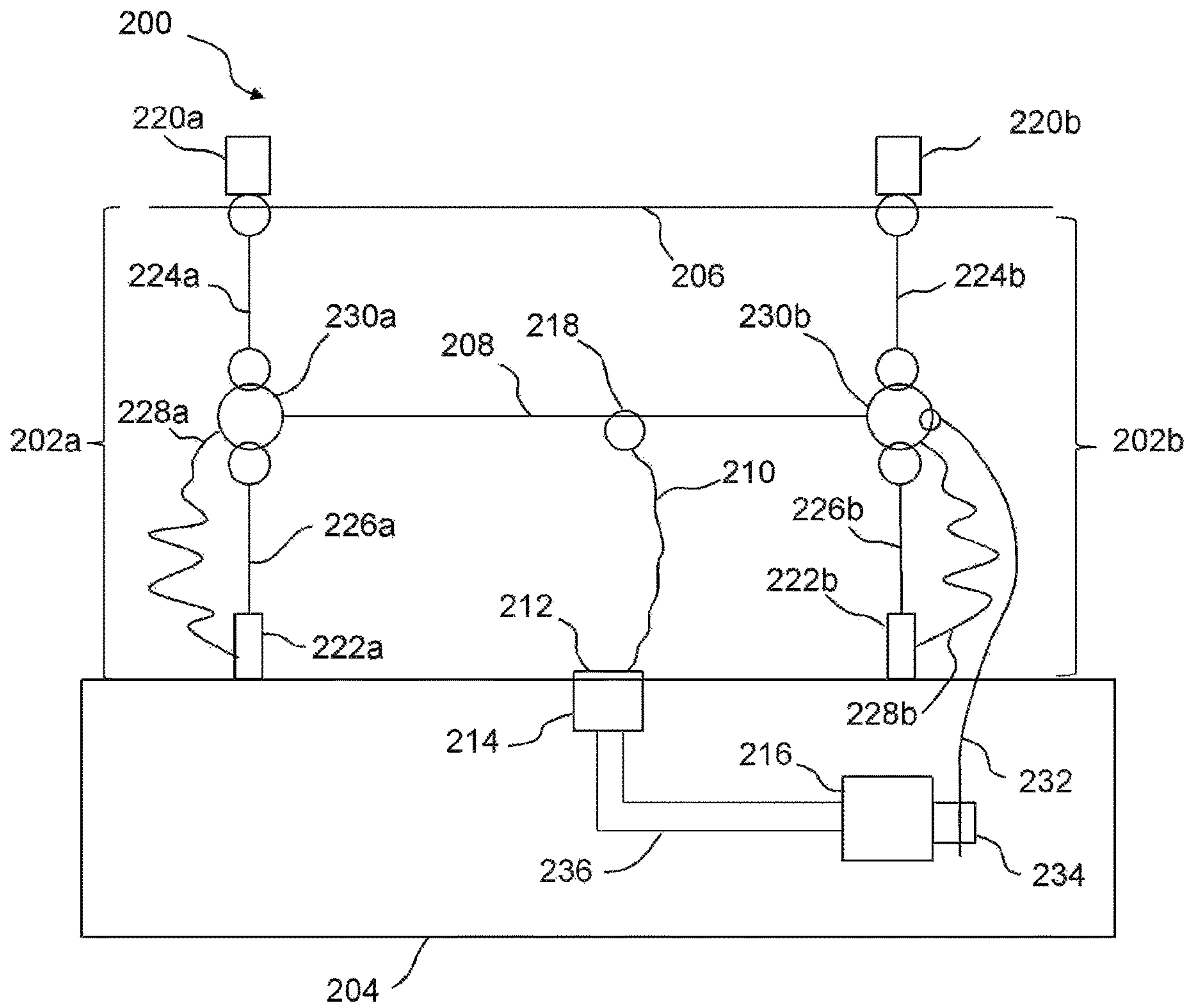


Figure 2a

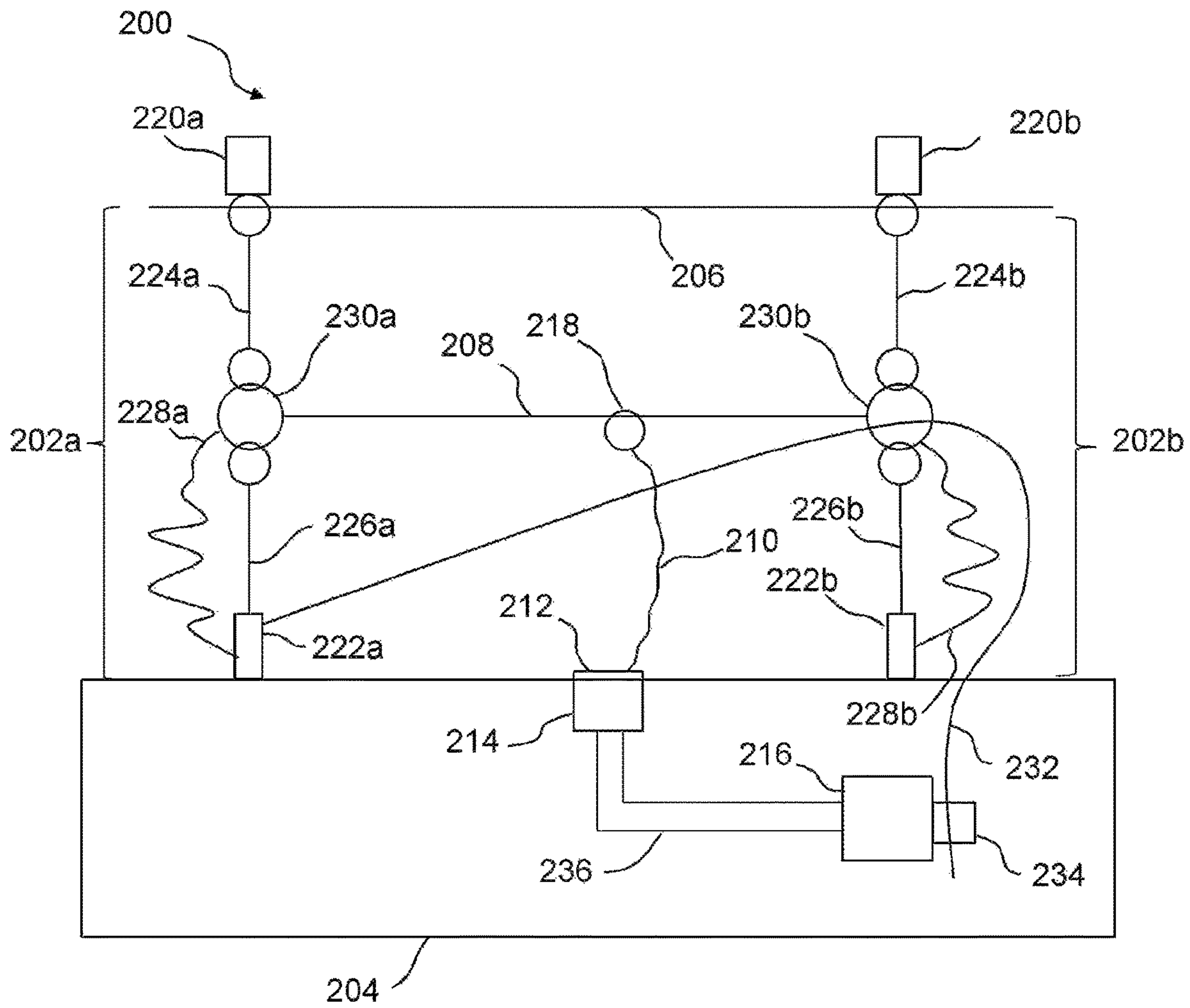


Figure 2b



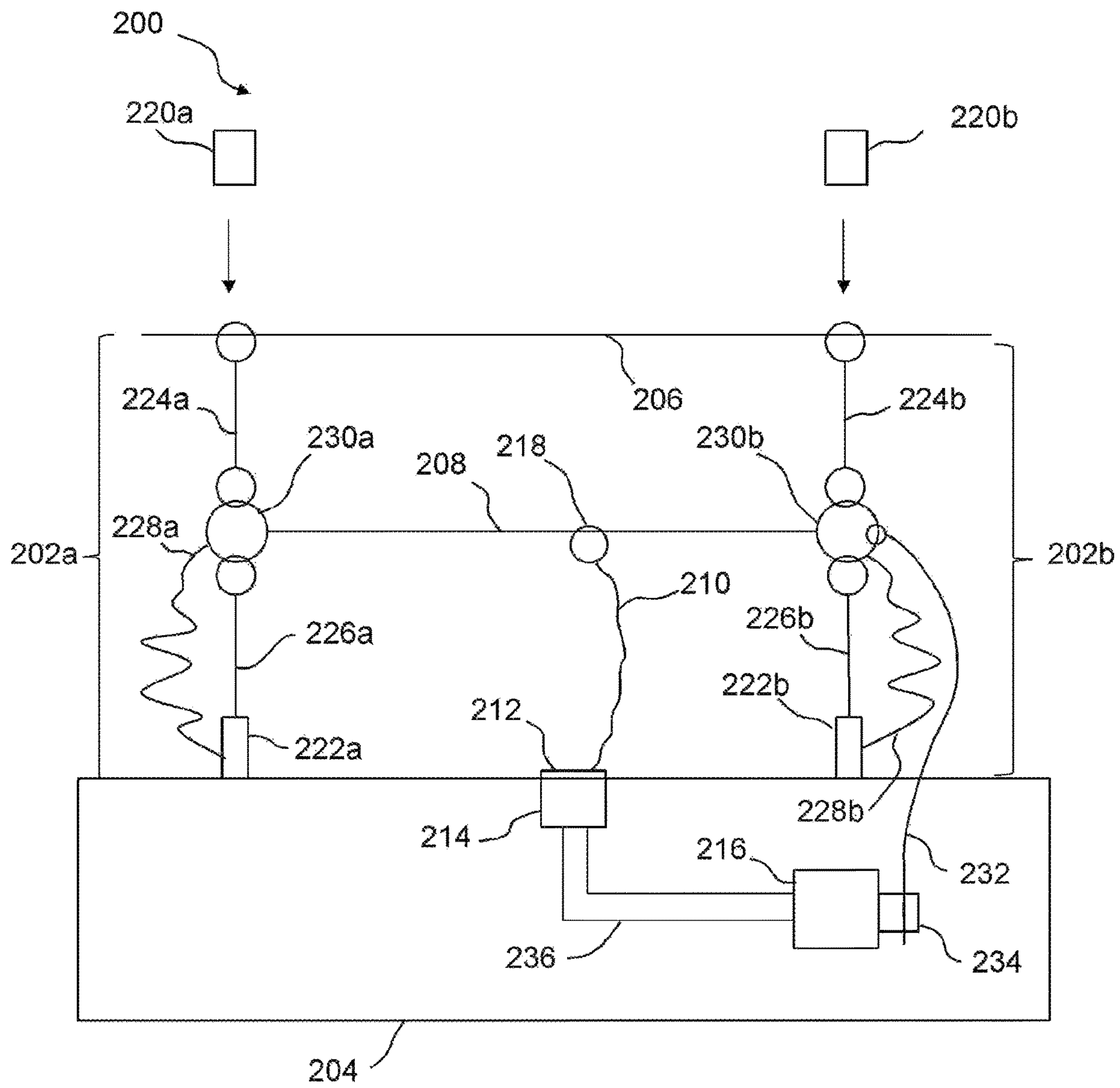


Figure 3

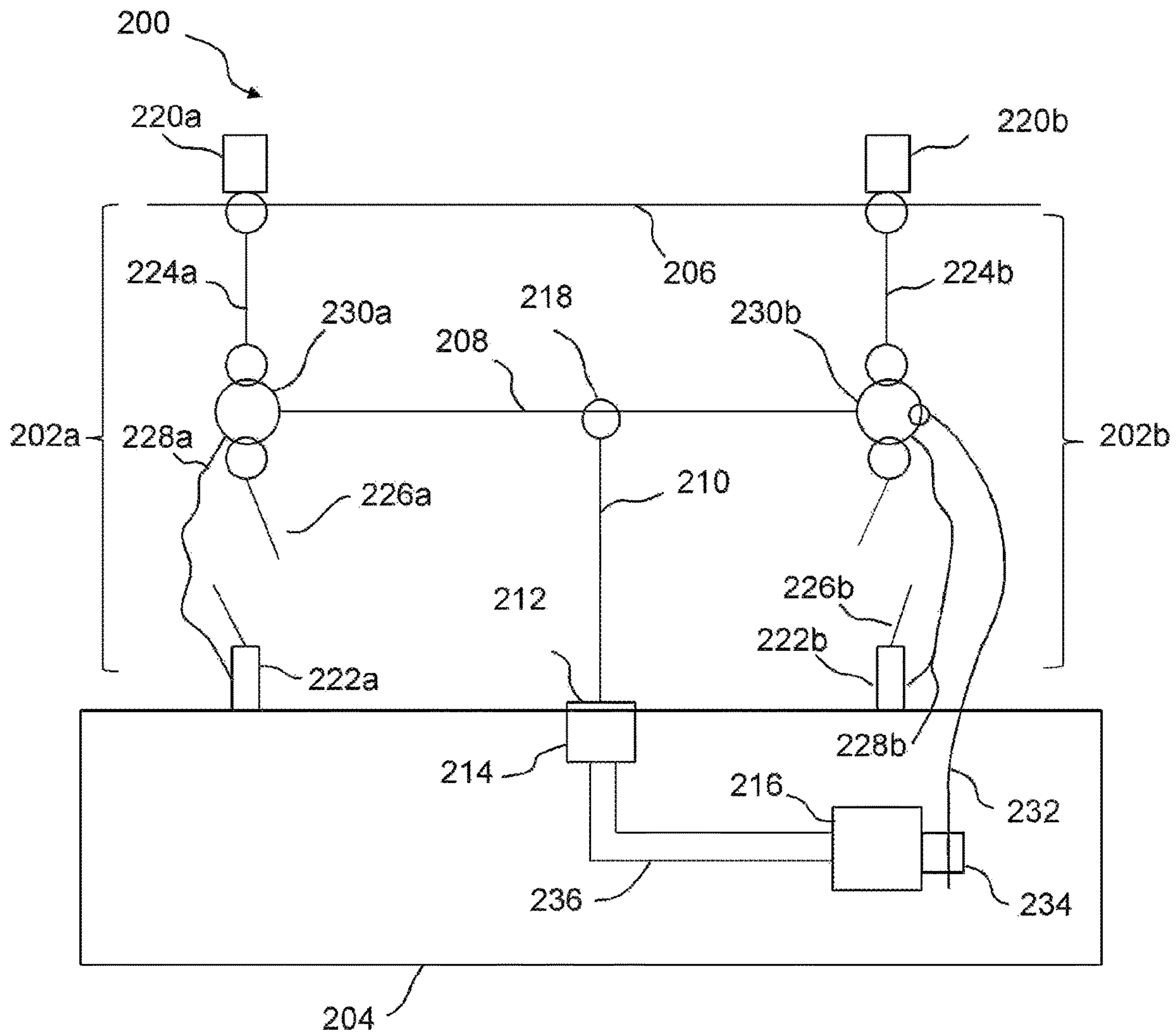


Figure 4

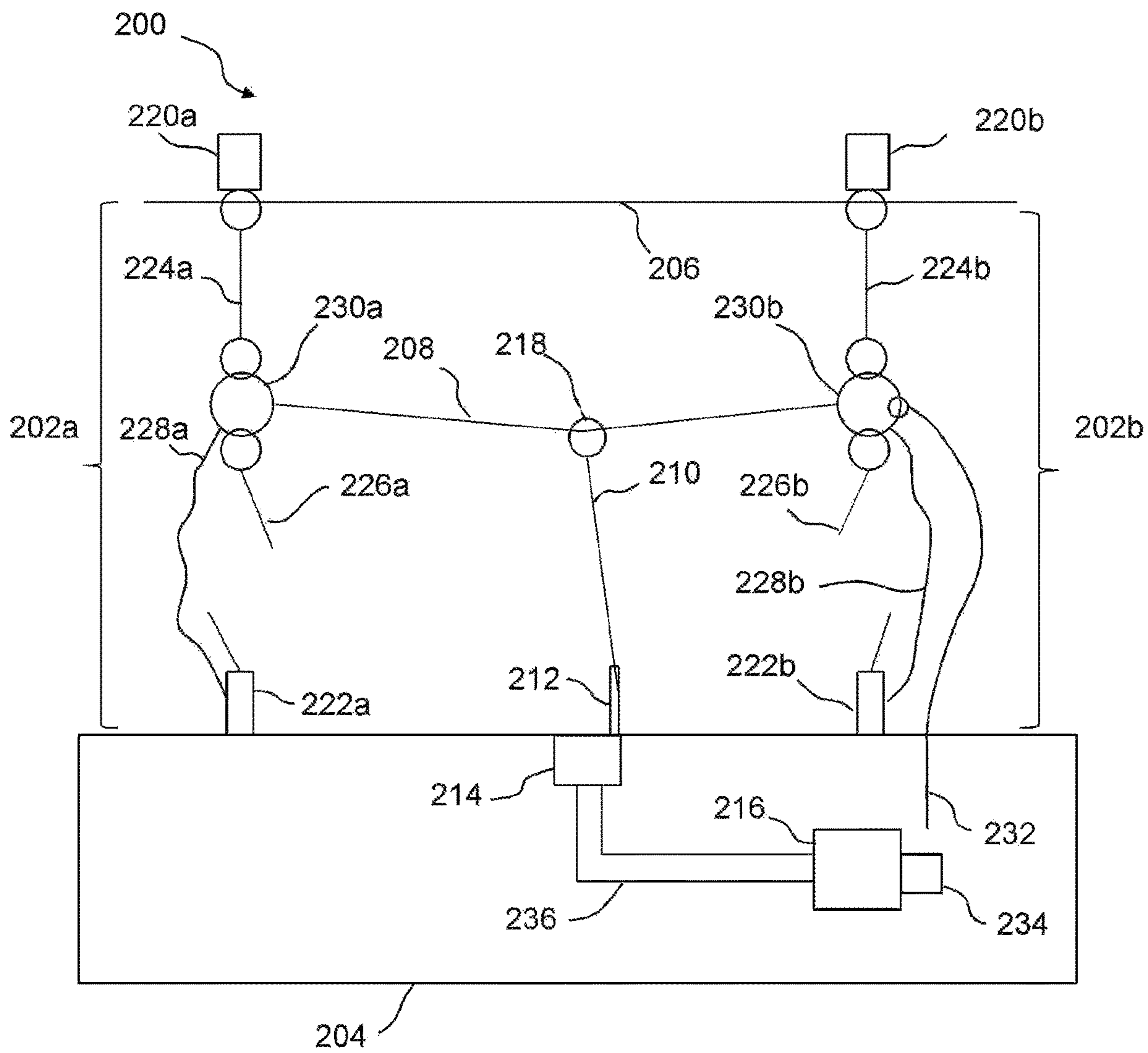


Figure 5



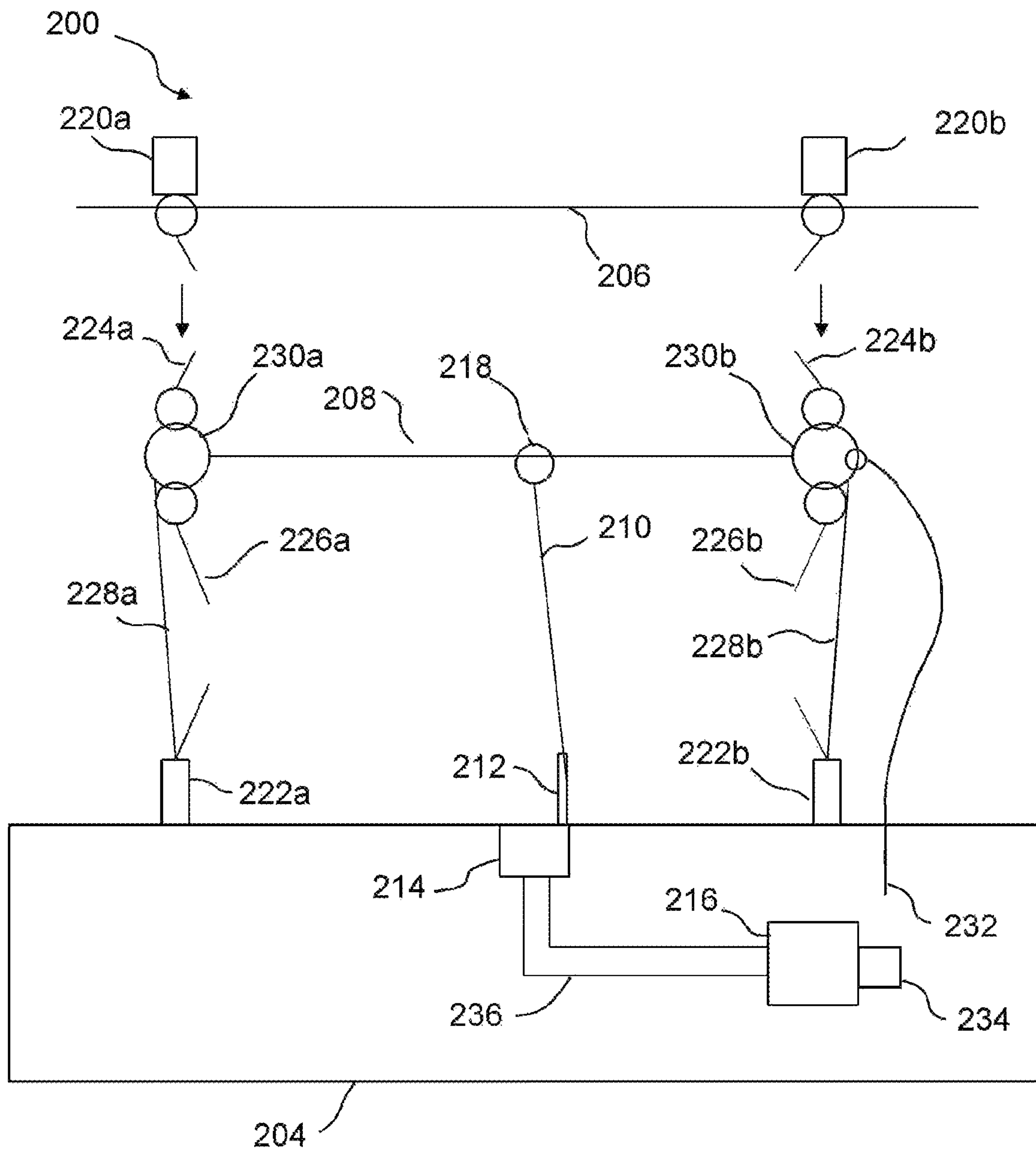


Figure 6

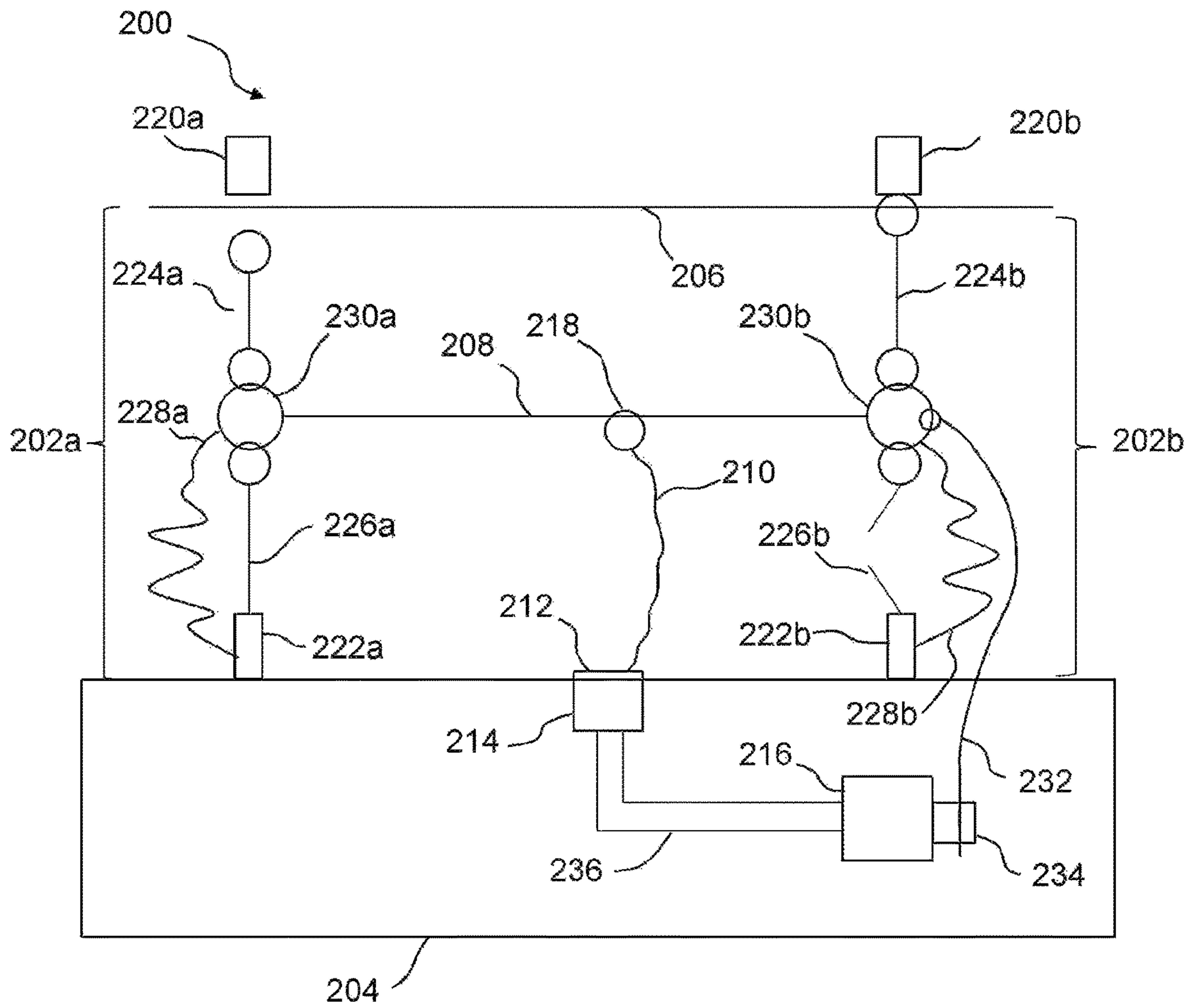


Figure 7a

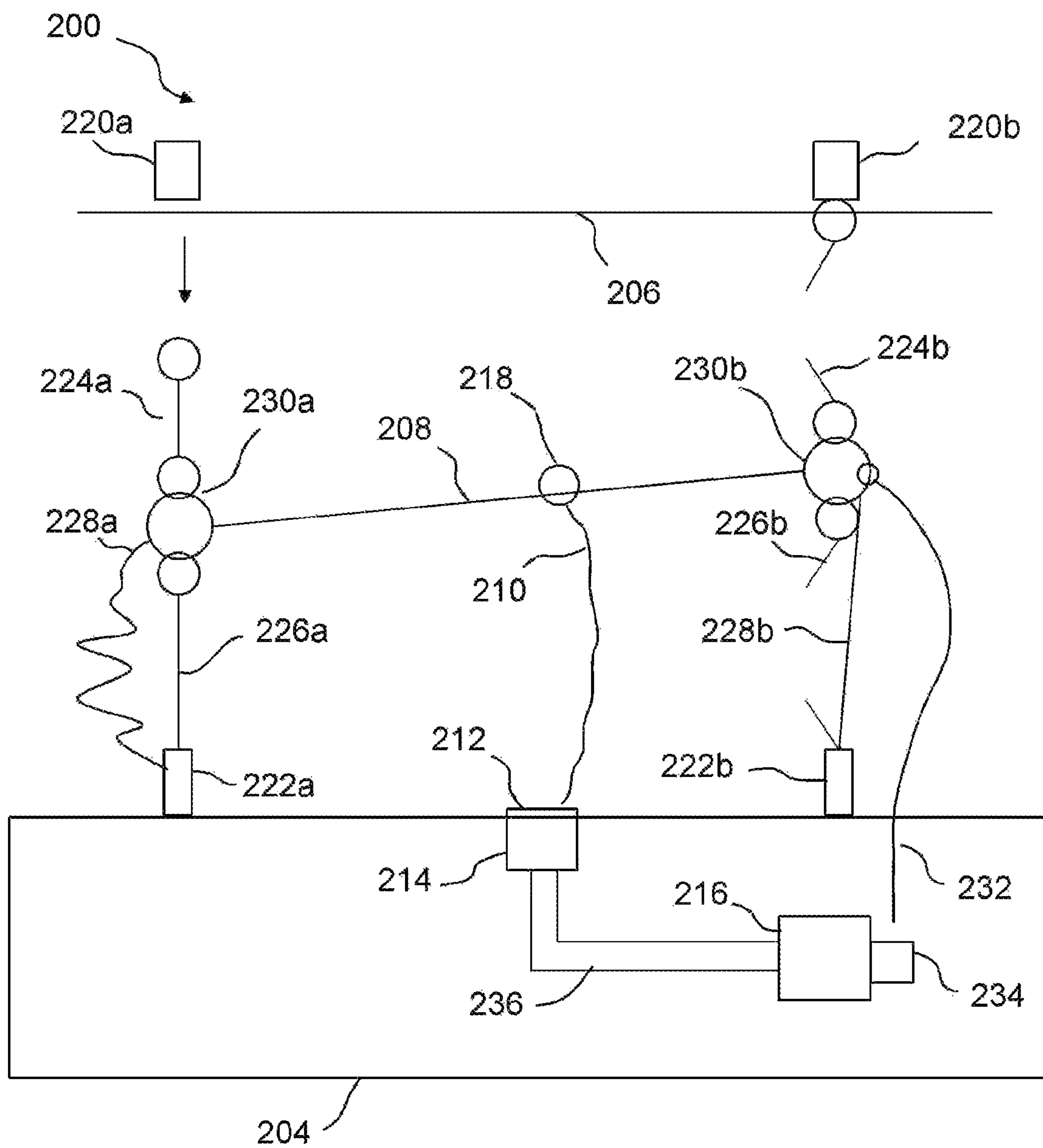


Figure 7b

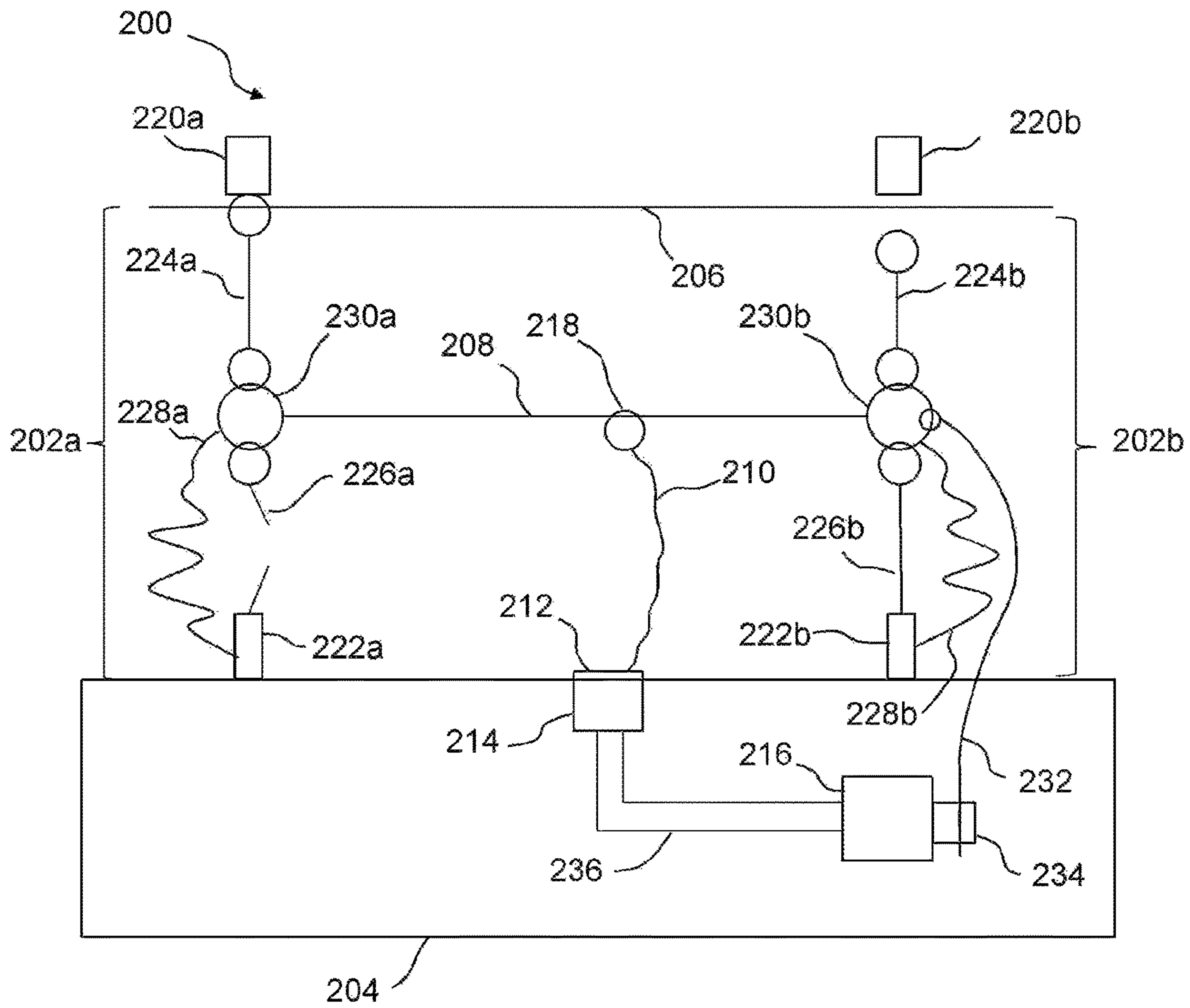


Figure 8a

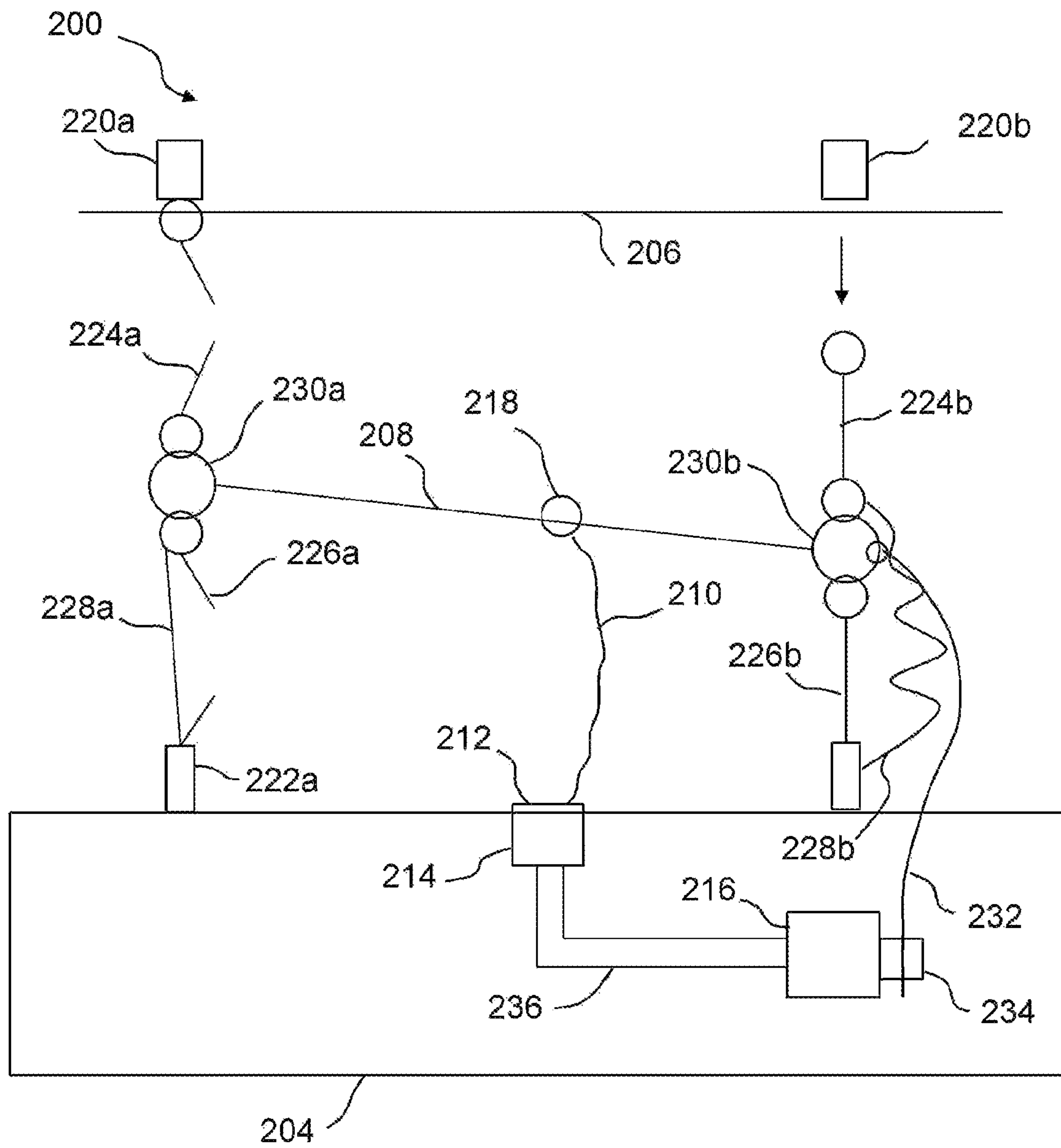


Figure 8b



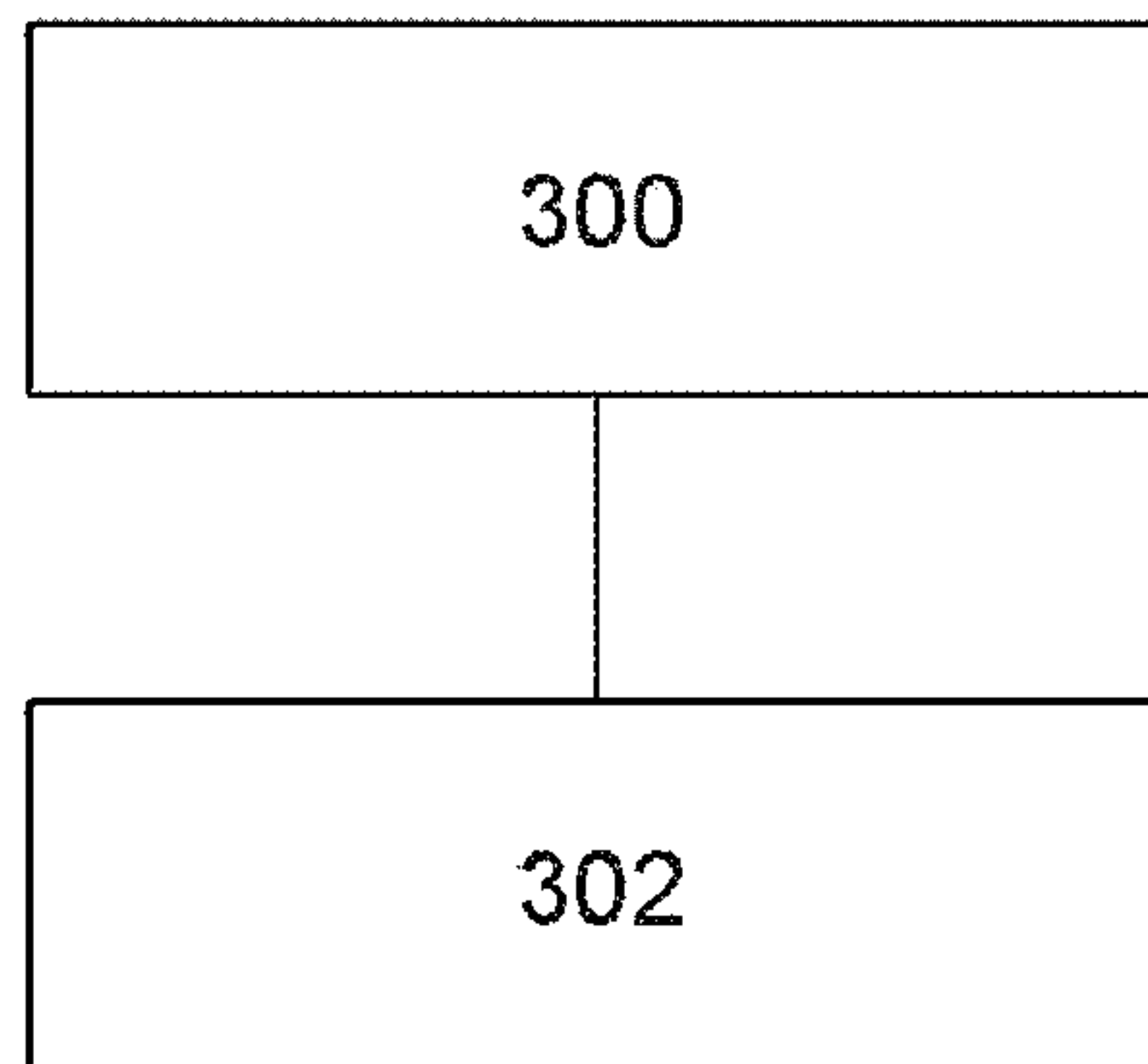


Figure 9

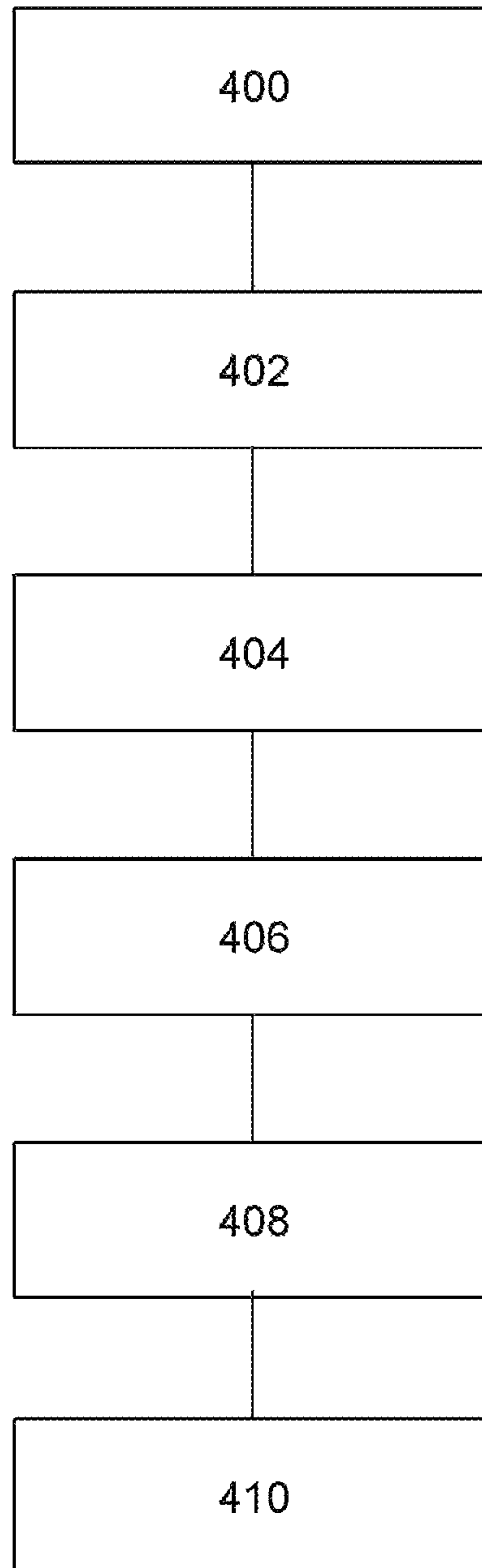


Figure 10

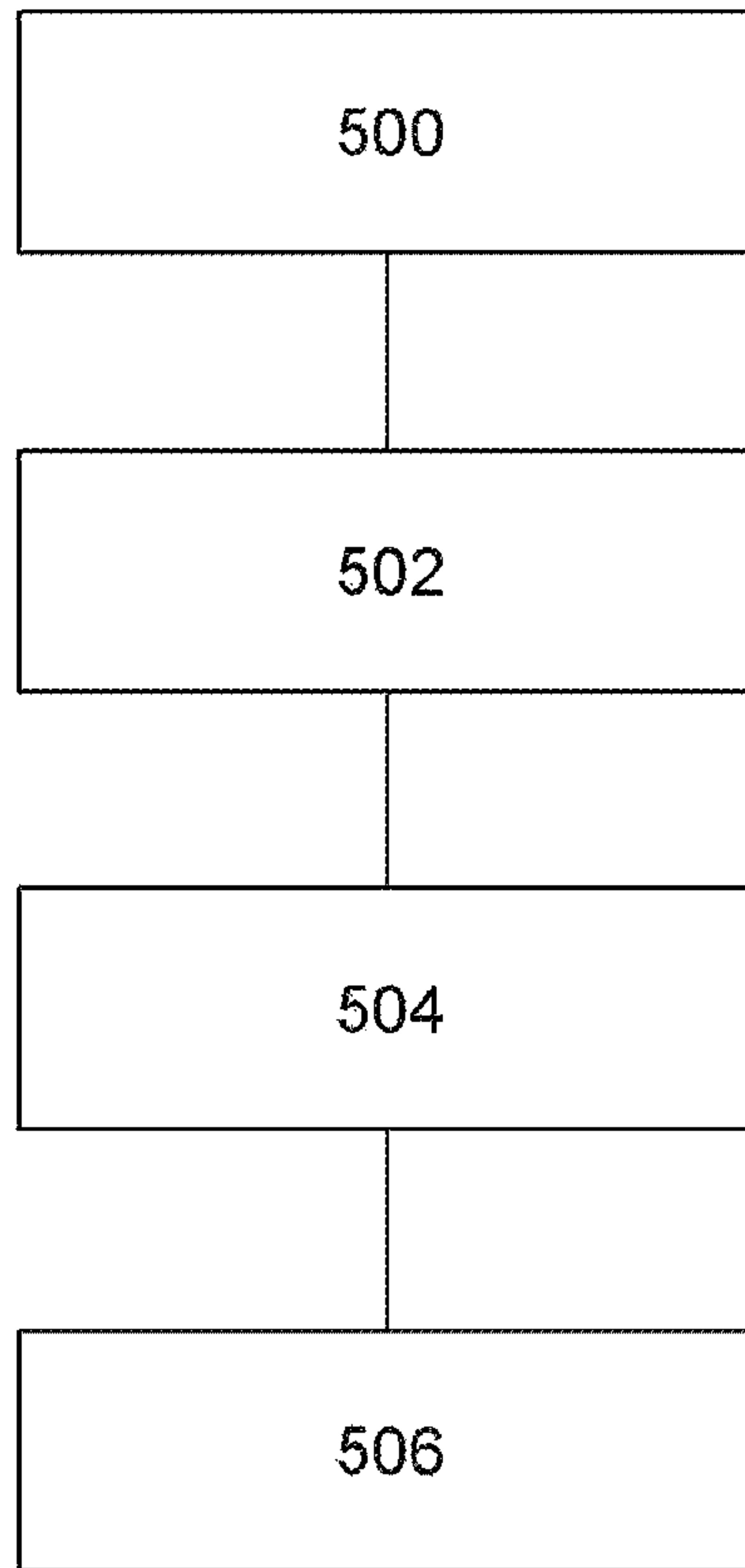


Figure 11

**ARMING APPARATUS**

## RELATED APPLICATIONS

This application is a national phase application filed under 35 USC § 371 of PCT Application No. PCT/GB2020/051759 with an international filing date of Jul. 23, 2020, which claims priority of GB Patent Application 1910996.6 filed on Aug. 2, 2019, and EP Patent Application 19201509.7 filed on Oct. 4, 2019. Each of these applications is herein incorporated by reference in its entirety for all purposes.

## FIELD

The present invention relates generally to an arming apparatus, and more particularly for an arming apparatus for use with a store, such as a munitions projectile.

## BACKGROUND

Ejector release units are typically installed on aircraft pylons or aircraft internal bays and are used for the carriage and release of stores, such as munitions projectiles. The store may be carried on the ejector release unit by means of two suspension hooks engaging with two store mounted suspension lugs. The ejector release unit may comprise a cartridge operated device or a pressurised gas device. When the ejector release unit is fired, it opens the suspension hooks and effectively “pushes” the store away from the aircraft to ensure it does not collide with the aircraft structure on release.

Certain fuze (sometimes referred to as “fuse”) systems for stores, may have a combination of electrical and mechanical inputs required for activation. Typically, and for reasons of safety, electrical power is not normally available within the fuze system prior to the release of the store and so power must be supplied from a source or generated by the store after release.

In one example, the supply of electric power is achieved via inductive transfer of energy from outside of the fuze system and outside of the store to the fuze system within the store. Alternatively, hard-wired connections might be used for the transfer of power, for example in the form of plug and socket like arrangements, or contact pins, and so on. In one example, the fuze system includes a deployable wind turbine that is operable to generate electricity via the turning of the wind turbine rotors to generate electricity and activate the electrical input of the fuze system.

The wind turbine is designed to be deployed during the release of the store. However, it is challenging to ensure that the wind turbine is deployed by a lanyard at an acceptable angle. If the wind turbine is deployed outside of acceptable parameters, then it will not operate correctly and could be damaged. Existing solutions require long lengths of lanyards to achieve this.

In addition, to ensure that lanyards are released with the store after they are operated, additional retaining wires are required, which leads to increased complexity. These additional wires and arming connectors need to be routed and secured correctly to ensure that they operate correctly. In order to do this, tape that remains secure during high speed carriage, such as speed tape, is often required to secure the arming connectors and additional wires to the store. There is a risk that the speed tape may peel and be removed during flight or after the release of the store, which may mean that the wires fail to operate as designed.

The fuze system enables the store to be carried on the aircraft in a safe condition. The store can be released in two ways, namely a jettison release in which the store is released in an unarmed condition and a live release in which the store is released in an armed condition. A store is usually jettisoned in an emergency, for example in a situation where an aircraft needs to reduce weight and aerodynamic drag. In this case the store is released, but the fuze system does not arm the munitions projectile, and the store will hit the ground but will not explode.

An alternative to a jettison release is a live release. In a live release, the fuze system is activated on release of the store. The fuze system arms the store at a safe distance from the launch aircraft to enable the store to explode at the required time.

In some examples, the store is activated by one or two independent electromagnetically operated, arming units. These are usually mounted at either end of the ejector release unit. In some examples, an additional electrical arming input is provided. In existing systems, there is a risk that during a jettison event, if one of the arming units fails, then the store will be released in an activated state.

It is an aim of example embodiments of the present invention to at least partially reduce or avoid one or more disadvantages of the prior art, discussed above or elsewhere, or to at least provide a viable alternative to existing arming apparatus.

## SUMMARY

In a first example, there is provided an arming apparatus for a store, the apparatus comprising: a first attachment system and a second attachment system; a linking connector coupled with the first attachment system and the second attachment system; and an arming connector coupled with the linking connector and a first fuze input of the store; wherein each of the first attachment system and the second attachment system comprises: an arming unit; a first frangible connector coupled with the arming unit and the linking connector; and a second frangible connector coupled with the linking connector and the store.

The provision of this arming apparatus removes the need for excessively long lengths of arming wires and lanyards, which could become trapped and damaged during installation or inadvertently operated by ground crew during weapon loading. Further, the requirement for speed tape is significantly reduced. The simplified cable routing allows for rapid assembly and it reduces the chance of operator errors. Further, the fusing system can be premade away from the aircraft in a controlled factory environment thus reducing the possibility of lanyard system assembly errors. The arming apparatus is configured such that all the connectors fall away with the store during a release. The arming apparatus also provides a system in which two arming units are both required to be activated in order for a live release of a store. Further, the apparatus provides an indication of what event has occurred, e.g, whether the store has been released as a live release, a jettison or a failed jettison event. When a store is released as a live release, the top portion of both of the first shear wires is retained in the arming units.

In contrast, in the event of a correct jettison event, both of the first shear wires are released in their entirety together with the store. In the event of a failed jettison event, which would indicate the one of the arming units is not operated correctly, then in a post flight check, one of the top portion of the first shear wires would have been retained in its respective arming unit. Further, the apparatus enables a lid



3

of a first input to be opened within the correct range of operating angles during a live release.

In one example, the gag rod wire coupled with the store and a second fuze input via the second attachment system. The gag rod wire provides a second input to the fuze system.

Each attachment system comprises a safety connector coupled with the linking connector and the store. The safety connector ensures that components of the first attachment system and the second attachment system fall away with the store.

The length of the safety connector may be longer than the length of the arming connector.

The linking connector may comprise a first ring and a second ring, the linking connector being coupled with the first attachment system via the first ring and with the second attachment system via the second ring.

One or more of the first frangible connector and the second frangible connector may comprise a shear wire.

The first frangible connector may have a higher breaking force compared with the breaking force of the second frangible connector. The first frangible connector may have a breaking force of between approximately 700 N and 1000 N.

The second frangible connector may have a breaking force of between approximately 100 N and 200 N.

The arming unit of each of the first attachment system and the second attachment system may comprise an arming solenoid, wherein the arming solenoid has first attachment force for the first frangible connector when the arming unit is energised and a second attachment force for the first frangible connector when the arming unit solenoid is unenergised.

The second attachment force may be greater than the breaking force of the first frangible connector.

The first attachment force may be lower than the breaking force of the second frangible connector.

In one example, upon activation of the ejector release unit and wherein the arming units are energised, the second frangible connector of the first and second attachment systems may be configured to break under the weight of the store, such that the load from the store is transferred to the ejector release unit via the arming connector thereby activating the first input of the fuze system.

The first frangible connector of the first and second attachment systems is configured to break following activation of the first input of the fuze system under the weight of the store.

In one example, there is provided a method of operating the arming apparatus comprising: energising the first arming unit and the second arming unit; and releasing the store from hooks of the ejection release unit.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Examples of the present disclosure will now be described with reference to the accompanying drawings, in which:

FIG. 1 shows an example of part of an example of existing arming apparatus;

FIG. 2 shows an example of a first example of the present disclosure;

FIG. 3 shows an example of a store being released from an ejector release unit during a jettison release;

FIG. 4 shows an example of the first stage of a release of a store from an ejector release unit during a live release;

FIG. 5 shows an example of the second stage of a release of a store from an ejector release unit during a live release;

4

FIG. 6 shows an example of the third stage of a release of a store from an ejector release unit during a live release;

FIG. 7a shows an example of the first stage of a release of a store from an ejector release unit during a failed jettison release in a first example;

FIG. 7b shows an example of the second stage of a release of a store from an ejector release unit during a failed jettison release in a first example;

FIG. 8a shows an example of the first stage of a release of a store from an ejector release unit during a failed jettison release in a second example;

FIG. 8b shows an example of the second stage of a release of a store from an ejector release unit during a failed jettison release in a second example;

FIG. 9 shows an example of the process steps of a jettison release of a store from an ejector release unit in a second example;

FIG. 10 shows an example of the process steps of a live release of a store from an ejector release unit; and

FIG. 11 shows an example of the process steps of a failed jettison release of a store from an ejector release unit.

#### DETAILED DESCRIPTION

FIG. 1 shows a side view of an example of known part of an arming apparatus 100. FIG. 1 shows an example of a connection between an ejector release unit (not shown) and a store 102 via an arming unit 104. In this example, one arming unit 104 works with one fuze system 118.

A first cable 106 is attached to the arming unit 104 via a swivel link assembly 108. The first cable 106 is coupled at a second end to a second cable 110 and a third cable 112 at a connection point 114. The connection point 114 may comprise a ring that receives a looped end or hook of each of the first cable 106, second cable 110 and third cable 112. The second cable 110 is attached to a lid 116 of an electrical input 118 of a fuze system (not shown). The third cable 112 is connected at one end to a suspension lug 120 of the store 102.

In this example, the lid 116 of the electrical input 118 system comprises a wind turbine. After the lid 116 is opened, the rotors of the wind turbine will rotate, which generates electricity for the electrical input of the fuze system 118. In order for the wind turbine to operate efficiently, it needs to be opened at a correct angle with respect to the store 102. As shown in FIG. 1, the first cable 106 and the second cable 110 are angled with respect to the vertical. The purpose of angling the first cable 106 and the second cable 110 with respect to the vertical is to enable the lid 116 of the electrical input 118 to be opened such that it is within an operating cone angle for the lid 116 of the electrical input 118.

The purpose of the third cable 112 is to ensure that the first cable 106 and the second cable 110 are released together as the store 122 is ejected. In other words, the first cable 106, the second cable 110 and the third cable 112 are removed from the arming unit 104 and remain attached to the store 122 and the store 122 has been ejected. In this existing system, relatively long lengths of cables are required in order to ensure that the lid 116 is opened within the acceptable operating cone angle.

Further, in the event of a failed jettison, i.e., the pilot intends to jettison the store 102, but the arming unit keeps a relatively high retaining force, the store 102 may be released in an armed state, which is highly undesirable.

FIG. 2 shows an example of a first example of an arming apparatus 200 for a store 204, such as a munitions projectile, according to the present disclosure. The arming apparatus



5

**200** includes a first attachment system **202a** and a second attachment system **202b**. Each of the first attachment system **202a** and the second attachment system **202b** is configured to link a store **204** to an ejector release unit **206**.

A linking connector **208** is coupled with the first attachment system **202a** and the second attachment system **202b** and is configured to extend between the first attachment system **202a** and the second attachment system **202b**. In one example, the linking connector **208** comprises a lanyard. In one example, the linking connector **208** is a fixed length element.

The arming apparatus **200** also comprises an arming connector **210** coupled with the linking connector **208** and a lid **212** of an electrical input **214** of a fuze system **216**. The electrical input **214** may be connected to the fuze system **216** via one or more wires **236**. In one example, the arming connector **210** is a fixed length element. the arming connector **210** may be coupled to the linking connector **208** via a coupling device **218**, such as a ring. In some examples, the coupling device **218** is integral with the arming connector **210**. The coupling device **218** can move along the linking connector **208** such that the angle between arming connector **210** and the lid **212** of the electrical input **214** may be self-adjusted, in use.

Once the lid **212** of the electrical input **214** is opened, it may be locked in place so that it remains open. In this example, the lid **212** of the electrical input **214** of the fuze system **216** comprises a wind turbine. After the **212** is opened, the rotors of the wind turbine will rotate, which generates electricity for the electrical input of the fuze system **216**.

The first attachment system **202a** is coupled to a first arming unit **220a** and a first lug **222a** of the store **204**. The second attachment system **202b** is coupled to a second arming unit **220b** and a second lug **222b**. In other words, each of the first attachment system **202a** and the second attachment system **202b** is coupled to a respective arming unit **220a**, **220b** and a respective lug **222a**, **222b** of the store **204**. In one example, the first lug **222a** is a forward lug of the store **204** and the second lug **222b** is a rearward lug of the store **204**. In this example, the first arming unit **220a** is a forward arming unit and the second arming unit **220b** is a rear arming unit.

Each of the first attachment system **202a** and second attachment system **202b** comprises a first frangible connector **224a**, **224b** coupled with the respective arming unit **220a**, **220b** and the linking connector **208**. In addition, each of the first attachment system **202a** and the second attachment system **202b** comprises a second frangible connector **226a**, **226b** coupled with the linking connector **208** and the store **204**. In one example, the second frangible connector **226a**, **226b** is coupled with a lug **222a**, **222b** of the store **204**. For example, the second frangible connector **226a** of the first attachment system **202a** is coupled to a first lug **222a** of the store **204** and the second frangible connector **226b** of the second attachment system **202b** is coupled with a second lug **222b** of the store **204**.

The first lug **222a** and the second lug **222b** may comprise bail lugs that are screwed into the store **204**. The first lug **222a** and the second lug **222b** may have loops for receiving the second frangible connectors **226a**, **226b** of the first attachment system **202a** and the second attachment system **202b**.

In one example, the linking connector **208** comprises a first connection point **230a** at a first end of the linking connector **208** and a second connection point **230b** at a second end of the linking connector. For example, the

6

linking connector **208** may comprise a first ring that defines the first connection point **230a** and a second ring that defines the second connection point **230b**. In other examples, the first connection point **230a** and the second connection point **230b** are part of the first attachment system **202a** and the second attachment system **202b** respectively.

The first frangible connector **224a** of the first attachment system **202a** may be configured to be coupled between the first arming unit **220a** and the first connection point **230a** and the first frangible connector **224b** of the second attachment system **202b** may be configured to be coupled between the second arming unit **220b** and the second connection point **230b**. Further, the second frangible connector **226a** of the first attachment system **202a** may be configured to be coupled between the first connection point **230a** and the first lug **222a** of the store **204**. The second frangible connector **226b** of the second attachment system **202b** may be configured to be coupled between the second connection point **230b** and the first lug **222b** of the store **204**.

The first frangible connector **224** is configured to break at a pre-determined load. For example, the first frangible connector **224** may have a breaking load or breaking force of between approximately 700 N and 1000 N. If the first frangible connector **224** is subject to a load of above the breaking force, then it will break. In one example, the first frangible connector **224** and the second frangible connector **226** are shear wires.

The second frangible connector **226** is also configured to break at a pre-determined load. In one example, the first frangible connector **224** has a higher breaking force compared with the breaking force of the second frangible connector **226**. In other words, the first frangible connector **224** may be subjected to a high load compared with the second frangible connector **226** before it breaks. As such, if subjected to the same load, the second frangible connector **226** is configured to break before the first frangible connector **224**. In this example, as an increasing load is applied to the first attachment system **202a** and the second attachment system **202b**, the second frangible connector **226** will be configured to break as the increasing load passes the breaking force of the second frangible connector **226**.

In one example, the second frangible connector **226** has a breaking load or breaking force of between 100 N and 200 N.

In one example, the arming apparatus **200** also comprises a first safety connector **228a** configured to be coupled between the linking connector **208** and the store **204**, for example, via the first connection point **230a** and the first lug **222a**. The arming apparatus **200** may also comprise a second safety connector **228b** configured to be coupled between the linking connector **208** and the store **204**, for example, via the second connection point **230b** and the second lug **222b**.

In one example, the length of the first safety connector **228a** and the second safety connector **228b** is substantially identical. Each of the first safety connector **228a** and the second safety connector **228b** has a longer length compared with the length of the arming connector **210**. Providing a first safety connector **228a** and second safety connector **228b** that are longer than the length of the arming connector **210** means that the electrical input **214** of the fuze system **216** will be activated prior to the first safety connector **228a** and second safety connector **228b** become taut, as will be discussed in more detail below.

In one example, the fuze system **216** comprises a first input **214** and a second input **234**, both of which are required to be activated to arm the fusing system **216**. As previously described, the first input **214** may be an electrical input and



the second input **234** may be a mechanical input such as a gag rod. A gag rod wire **232** passes through the second input **234**. In operation, to activate the second input **234** a gag rod wire **232** needs to be physically removed from the gag rod **234**.

FIG. **2a** shows an example of the gag rod wire **232** being coupled with the second input **234** of the fuze system **216** and the second attachment system **202b**, for example, the second connection point **230b** of the second attachment system **202b**.

FIG. **2b** shows an alternative example of an arming apparatus **200** for a store **204**. The example in FIG. **2b** is identical to the example shown in FIG. **1a**, except that the gag rod wire **232** passes through the second connection point **230b** of the linking connector **208** and is coupled with the first lug **222a** of the store **204**.

FIGS. **3** to **8** show the gag rod wire **232** being coupled to the second attachment system **202b** as shown in FIG. **2a**. However, in each of these figures, the gag rod wire **232** may be coupled with the first lug **222a** of the store **204** as shown in FIG. **2b**.

Each of the first attachment system **202a** and the second attachment system **202b** comprises an arming unit **220a**, **220b**. The arming unit **220a**, **220b** may be configured to couple the attachment systems to the ejector release unit **206**, e.g. a first arming unit **220a** couples the first attachment system **202a** to the ejector release unit **206** and the second arming unit **220b** couples the second attachment system **202b** to the ejector release unit **206**. In one example, each of the arming units (**220a**, **220b**) comprises an arming solenoid. A pilot may energise the arming unit **220a**, **220b** to change the pull-out force required to remove the first frangible connector **224** from the arming unit **220**. In one example, the arming unit **220** has a relatively low pull-out force when it is unenergised and a relatively high pull-out force when the arming unit is energised. In one example, the pull-out force of the first frangible connector **224a**, **224b** from the arming unit **220a**, **220b** when it is unenergised is between approximately 35 N and 70 N. The pull-out force of the first frangible connector **224a**, **224b** from the arming unit **220a**, **220b** when it is energised is above approximately 1100 N. In some examples, the unenergised pull-out force of the first frangible connector **224a**, **224b** from the arming unit **220a**, **220b** is lower than the break strength of the second frangible connector **226a**, **226b**. In one example, the energised pull-out force of the first frangible connector **224a**, **224b** from the arming unit **220a**, **220b** is higher than the breaking strength of the second frangible connector **226a**, **226b**. The weight of the store **204** is more than twice the breaking strength of the first frangible connector **224a**, **224b**, the breaking strength of the second frangible wire **226a**, **226b** and the pull-out force of the arming units, whether in an unenergised or energised state.

In one example, the store **204** is coupled to the aircraft via one or more ejector release unit suspension hooks (not shown). The ejector release unit suspension hooks are controllable by the pilot to enable the pilot to release the store **204** from the suspension hooks in operation.

The jettison sequence of the system will now be described. The initial state of the arming apparatus **200** is shown in FIG. **2**. The arming units **220a**, **220b** are in an unenergised state, such that they have a relatively low pull-out force requirement.

The pilot will activate the jettison sequence. This causes the store **204** to be released from the ejector release unit

suspension hooks. In some examples, at this stage, the store **204** may be pushed away from the aircraft by one or more ejector release unit rams.

FIG. **3** shows the next stage of the jettison sequence of the arming apparatus **200**. The weight of the store **204** will be transferred to the first attachment system **202a** and the second attachment system **202b**. In other words, the weight of the store **204** will be transferred to the ejector release unit **206** via the second frangible connector **226a**, **226b**, the first frangible connector **224a**, **224b** and the arming unit **220a**, **220b** of each of the first attachment system and the second attachment system **202b**. As the arming units **220a**, **220b** are in an unenergised state, there is a relatively low pull-out force required to remove the first frangible connectors **224a**, **224b** from the respective arming units **220a**, **220b**. The breaking strengths of the first frangible connector **224a**, **224b** and the second frangible connector **226a**, **226b** is higher than the pull-out force of the first frangible connectors **224a**, **224b** from the arming units **220a**, **220b** in the unenergised state. As such, the weight of the store **204** will pull the respective first frangible connectors **224** from the respective arming units **220**, as shown by the arrows in FIG. **3**.

In this example, the first frangible connector **224a**, **224b**, the second frangible connector **226a**, **226b**, the linking connector **208**, the arming connector **210** and the safety connectors **228** are released together with the store **204**. The gag rod wire **232** is not removed from the fuze system **216** and the lid **212** of an electrical the input **214** of a fuze system **216** is not opened. Therefore, in the jettison sequence, neither of the two inputs of the fuze system **216** are activated and the store **204** is released in an unarmed state.

The live release sequence of the system will now be described. The initial state of the arming apparatus **200** is shown in FIG. **2**. The pilot initiates the live release sequence, which energises the arming units **220a**, **220b**. As such, the pull-out force of the first frangible connectors **224a**, **224b** from the arming units **220a**, **220b** is increased to above the breaking strengths of first frangible connectors **224a**, **224b** and the second frangible connectors **226a**, **226b**.

The store **204** is then released from the ejector release unit suspension hooks. In some examples, at this stage, the store **204** may be pushed away from the aircraft by one or more ejector release unit rams.

FIG. **4** shows the example of the next stage of the live release sequence. Following the release of the store **204** from the ejector release unit suspension hooks, the weight of the store **204** is transferred to the ejector release unit **206** via the first attachment system **202a** and the second attachment system **202b**. In this example, the weakest element in each of the attachment systems **202a**, **202b** is the second frangible connector **226a**, **226b**. As such, the second frangible connector **226a**, **226b** of each of the attachment systems **202** breaks because the weight of the store is greater than the breaking strength of the second frangible connector **226a**, **226b** and the limiting factor in each of the attachment systems is the strength of the second frangible connector **226a**, **226b**.

As shown in FIG. **4**, following the breaking of the second frangible connectors **226a**, **226b**, the load path of the store **204** now passes through the arming connector **210** and so the arming connector **210** becomes taut.

FIG. **5** shows the next stage of the live release sequence. Due to the load path travelling through the arming connector **210**, the lid **212** of the first input **214** of the fuze system **216** is opened. As such, the first input **214** of the fuze system **216** will be activated.



As the store 204 has dropped further from the ejector release unit 206, the gag rod wire 232 is removed from the second input 234 of the fuze system 216, which enables the fuze system 216 to be activated by electrical power from the electrical input 214. Therefore, both the first input 214 and the second input 234 of the fuze system 216 are activated.

FIG. 5 shows that the linking connector 208 may deform as the weight of the store 204 is transferred to from through the arming connector 210 to the linking connector 208 to each of the first frangible connectors 224a, 224b of each of the first attachment system and the second attachment system 202. In one example, the linking connector 208 is deformed to have a “V-shape”. In the example in which the arming connector 210 is coupled to the linking connector 208 via the coupling device 218, the coupling point between the arming connector 210 and the linking connector 208 may change. The provision of the coupling device 218 means that the lid 212 of the first input 214 is opened within the correct range of operating angles.

FIG. 6 shows the next stage of the live release sequence. After the lid of the first input 214 is opened, the safety connectors 228a, 228b become taut and the load path of the store 204 to the ejector release unit 206 passes through the safety connectors 228a, 228b to the first frangible connectors 224a, 224b to the arming units 220a, 220b of each of the attachment systems 202a, 202b. The next limiting factor of the system 200 is the strength of the first frangible connectors 224a, 224b and these will break, as shown in FIG. 6. The store 204 will fall away from the ejector release unit 206 as indicated by the arrows in FIG. 6. As the first frangible connectors 224a, 224b break, the store 204 is no longer connected to the ejector release unit 206 and will be released in a live state as both the first input 214 and the second input 234 of the fuze system 216 are activated. The safety connectors 228a, 228b ensure that the various connectors are released together with the store 204 to avoid them causing damage to the aircraft due to them flailing under the aircraft. The safety connectors 228a, 228b ensure that the various connectors that are released remain attached to the store 204.

A failed jettison sequence of the system 200 will now be described. The starting condition is shown initially in FIG. 2a or 2b. As per the normal jettison sequence, in a failed jettison event neither of the arming units 220a, 220b are energised. However, one of the arming units, may become in a locked state such that it acts as if it has been energised and has a relatively high pull-out force of the first frangible connector 224b from the second arming unit 220b. In one example, the arming unit 220a, 220b may become locked due to internal wear of components that creates dust that jams the internal mechanism of the arming units 220a, 220b.

FIG. 7a shows the first stage of a failed jettison event in which the second arming unit 220b has failed and is in a locked state. Following the release of the store 204 from the ejector release unit suspension hooks, the weight of the store 204 is transferred to the ejector release unit 206 via the first attachment system 202a and the second attachment system 202b. In this example, in the first attachment system 202a, the first frangible connector 224a is released from the first arming unit 220a as per the standard jettison event. However, in the second attachment system 202b, the first frangible connector 224b is locked in the arming unit 220b and so isn't released as intended.

The linking connector 208 may begin to pivot or rotate as the first attachment system 202a separates downwards away from the first arming unit 220a. The next weakest element is the second frangible connector 226b and the load path from the store 204 to the ejector release unit 206 will pass through

the second attachment system 202b, which causes the second frangible connector 226b to break.

The next stage of the failed jettison event is that the safety connector 228b of the second attachment system 202b will become taut as the store 204 drops away. As the store 204 drops away, the gag rod wire 232 will be removed from the second input 234 of the fuze system 216. FIG. 7b shows the example of a failed jettison event in which the safety connector 228b of the second attachment system 202b has become taut. In this scenario, the load path of the store 204 to the ejector release unit 206 will be through the first frangible connector 224b of the second attachment system 202b. This causes the first frangible connector 224b of the second attachment system 202b to break as the weight of the store 204 is higher than the breaking strength of the first frangible connector 224b. As such, the store 204 will be released from the ejector release unit 206 without the first input 214 of the fuze system 216 being activated. Therefore, even in the failed jettison event, the store 204 is not activated and the store is released in a safe condition. The arming apparatus 200 includes two arming units 220a, 220b that are interconnected by connectors, which provides an automated protection system, such that if one arming unit 220a, 220b fails during a jettison event, the store 204 will still be released in an unarmed condition.

The starting condition is shown initially in FIG. 2a or 2b. As per the normal jettison sequence, in a failed jettison event neither of the arming units 220a, 220b are energised. However, one of the arming units, may become in a locked state such that it acts as if it has been energised and has a relatively high pull-out force of the first frangible connector 224b from the second arming unit 220b. In one example, the arming unit 220a, 220b may become locked due to internal wear of components that creates dust that jams the internal mechanism of the arming units 220a, 220b.

FIG. 8a shows the first stage of a failed jettison event in which the first arming unit 220a has failed and is in a locked state. Following the release of the store 204 from the ejector release unit suspension hooks, the weight of the store 204 is transferred to the ejector release unit 206 via the first attachment system 202a and the second attachment system 202b. In this example, in the second attachment system 202b, the first frangible connector 224b is released from the second arming unit 220b as per the standard jettison event. However, in the first attachment system 202a, the first frangible connector 224a is locked in the first arming unit 220a and so isn't released as intended.

The linking connector 208 may begin to pivot or rotate as the second attachment system 202b separates downwards away from the second arming unit 220b. The next weakest element is the second frangible connector 226a and the load path from store 204 to the ejector release unit 206 will pass through the first attachment system 202a, which causes the second frangible connector 226a to break.

The next stage of the failed jettison event is that the safety connector 228a of the first attachment system 202a will become taut as the store 204 drops away. In this example, as the store 204 drops away, the gag rod wire 232 may not be removed from the second input 234 of the fuze system 216. FIG. 8b shows the example of a failed jettison event in which the safety connector 228a of the first attachment system 202a has become taut. In this scenario, the load path of the store 204 to the ejector release unit 206 will be through the first frangible connector 224a of the first attachment system 202a. This causes the first frangible connector 224a of the first attachment system 202a to break as the weight of the store 204 is higher than the breaking strength



## 11

of the first frangible connector **224a**. As such, the store **204** will be released from the ejector release unit **206** without either the first input **214** of the fuze system **216** or the second input **234** of the fuze system **216** being activated. Therefore, even in the failed jettison event, the store **204** is not activated and the store is released in a safe condition. The arming apparatus **200** includes two arming units **220a**, **220b** that are interconnected by connectors, which provides an automated protection system, such that if one arming unit **220a**, **220b** fails during a jettison event, the store **204** will still be released in an unarmed condition.

The provision of this arming apparatus **200** removes the need for excessively long lengths of arming wires and lanyards, which could become trapped and damaged during installation or inadvertently operated by ground crew during weapon loading. Further, the requirement for speed tape is significantly reduced. The simplified cable routing allows for rapid assembly and it reduces the chance of operator errors. Further, the fusing system **216** can be premade away from the aircraft in a controlled factory environment thus reducing the possibility of lanyard system assembly errors. The arming apparatus **200** is configured such that all the connectors fall away with the store **204** during a release.

The apparatus provides an indication of what event has occurred, e.g. whether the store **204** has been released as a live release, a jettison or a failed jettison event.

When a store **204** is released as a live release, the top portion of the first shear wire **224a** and **224b** is retained in the arming units **220a** and **220b** as shown in FIG. 6.

In contrast, in the event of a correct jettison event, as shown in FIG. 3, both of the first shear wires **224a** and **224b** are released in their entirety together with the store **204**.

In the event of a failed jettison event, which would indicate the one of the arming units **220a**, **220b** is not operated correctly, then in a post flight check, one of the tops of the shear wires **224a**, **224b** would have been retained in the respective arming units **220a**, **220b**, as shown in either FIG. 7b or FIG. 8b.

FIG. 9 shows an example of a method of performing a jettison release according to one example. At step **300**, the pilot initiates the release of the store **204** without energising the arming units **220a**, **220b**. At step **302**, the first frangible connector of **224a**, **224b** is released from the arming unit **220a**, **220b** of each of the first attachment system **202a** and second attachment system **202b** to release the store **204** from the ejector release unit **206** in an unarmed state.

FIG. 10 shows an example of a method of performing a live release according to one example. At step **400**, the pilot energises the arming units **220a**, **220b**. At step **402**, the store **204** is released from the ejector release unit suspension hooks.

At step **404**, the second frangible connector **226a**, **226b** of each of the first and second attachment systems **202a**, **202b** breaks due to the weight of the store **204**.

At step **406**, the lid **212** of the first input **214** is opened due to the weight of the store **204** passing through the arming connector **210**.

At step **408**, the gag rod is released from the second input **234** of the fuze system **216**.

At step **410**, the first frangible connector **224a**, **224b** of the first and second attachment systems **202a**, **202b** breaks due to the weight of the store, thereby releasing the store **204** from the ejector release unit **206**.

FIG. 11 shows an example of a steps of a failed jettison event.

At step **500**, the pilot initiates the release of the store **204** without energising the arming units **220a**, **220b**. However,

## 12

one of the arming units **220** fails. In this example, it is the second arming unit **220b** that fails, but in other examples, the first arming unit **220** may fail and the same process applies.

At step **502**, the first frangible connector of **224a** is released from the arming unit **220a** of the first attachment system **202a**, but the first frangible connector **224b** is retained in the arming unit **220b** of the second attachment system.

At step **504**, the second frangible connector **226b** of the second attachment system **202b** breaks due to the weight of the store **204**.

As step **506**, the second safety connector **228b** becomes taut and transfers the load to the first frangible connector **224b** of the second attachment system **202b** such that the first frangible connector **224b** of the second attachment system **202b** breaks due to the weight of the store **204**, thereby releasing the store **204** from the ejector release unit **206**.

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

What is claimed is:

1. An arming apparatus (**200**) for a store (**204**), the apparatus comprising:

a first attachment system (**202a**) and a second attachment system (**202b**);

a linking connector (**208**) coupled with the first attachment system (**202a**) and the second attachment system (**202b**); and

an arming connector (**210**) coupled with the linking connector (**208**) and a first fuze input (**214**) of the store (**204**);

wherein each of the first attachment system (**202a**) and the second attachment system (**202b**) comprises:

an arming unit (**220**);

a first frangible connector (**224**) coupled with the arming unit (**220**) and the linking connector (**208**); and

a second frangible connector (**226**) coupled with the linking connector (**208**) and the store (**204**).

2. The apparatus (**200**) according to claim 1, comprising a gag rod wire (**232**) coupled with the store (**204**) and a second fuze input (**234**) via the second attachment system (**202b**).



## 13

3. The apparatus (200) according to claim 1, wherein each attachment system (202a, 202b) comprises a safety connector (228a, 228b) coupled with the linking connector (208) and the store (204).

4. The apparatus (200) according to claim 3, wherein the length of the safety connector (228a, 228b) is longer than the length of the arming connector (210).

5. The apparatus (200) according to claim 1, wherein the linking connector (208) comprises a first ring and a second ring, the linking connector (208) being coupled with the first attachment system (202a) via the first ring and with the second attachment system (202b) via the second ring.

6. The apparatus (200) according to claim 1, wherein one or more of the first frangible connector (224a, 224b) and the second frangible connector (226a, 226b) comprises a shear wire.

7. The apparatus (200) according to claim 1, wherein the first frangible connector (224a, 224b) has a higher breaking force compared with the breaking force of the second frangible connector (226a, 226b).

8. The apparatus (200) according to claim 7, wherein the first frangible connector (224a, 224b) has breaking force of between approximately 700N and 1000N.

9. The apparatus (200) according to claim 7, wherein the second frangible connector (226a, 226b) has a breaking force of between approximately 100N and 200N.

10. The apparatus (200) according to claim 1, wherein the arming unit (220a, 220b) of each of the first attachment system (202a) and the second attachment system (202b) comprises an arming solenoid, wherein the arming solenoid

## 14

has a first attachment force for the first frangible connector (224a, 224b) when the arming unit is energised and a second attachment force for the first frangible connector (224a, 224b) when the arming unit solenoid is unenergised.

11. The apparatus (200) according to claim 10, wherein the second attachment force is greater than a breaking force of the first frangible connector (224a, 224b).

12. The apparatus (200) according to claim 11, wherein the first attachment force is lower than a breaking force of the second frangible connector (226a, 226b).

13. The apparatus (200) according to claim 11, wherein upon activation of an ejector release unit and wherein the arming units are energised, the second frangible connector (226a, 226b) of the first and second attachment systems (202a, 202b) are configured to break under the weight of the store (204), such that the load from the store is transferred to the ejector release unit via the arming connector (210) thereby activating the first input (214) of the fuze system (216).

14. The apparatus (200) according to claim 13, wherein the first frangible connector (224a, 224b) of the first and second attachment systems (202a, 202b) is configured to break following activation of the first input (214) of the fuze system (216) due to the weight of the store (204).

15. A method of operating the arming apparatus (200) according to claim 1, the method comprising:

energising the first arming unit and the second arming unit; and

releasing the store from hooks of an ejector release unit.

\* \* \* \* \*